allow all pending claims 25 – 80 or make a proper and sufficient prima facie showing under 35 U.S.C. §103 why not.

Remarks

(1) Real Party In Interest. Sikora Industrieelektronic GmBH, Bremen, Federal Republic of Germany.

(2) Related Appeals and Interferences. None.

(3) Status of Claims. Pending are claims 25 – 80. All stand rejected as obvious under 35 USC § 103 (and on no other grounds). Previously pending claims 1 – 24 were cancelled before the first Examiner's Action in this application.

(4) Status of Amendments. No amendments were submitted after any final Examiner's Action in this application.

(5) Summary of Invention. The invention relates to measuring a dimension of an article by illuminating a portion of the article with a beam of light that has a non-planar wavefront, receiving the light on an array, and analyzing signals relating to the intensity of the received light using Fresnel diffraction theory. The invention takes advantage of diffraction patterns from light that is assumed to have a non-planar (or fan-shaped) wavefront.

According to all claims at issue (all are process claims), information from the array is evaluated (1) according to Fresnel diffraction theory; (2) according to the assumption that the wavefront from the light source is nonplanar, and (3) by distancing the source, article and array such that the intensity pattern in the vicinity of one shadow edge cast by the article is at most negligably superimposed on the intensity pattern in the vicinity of the other or another shadow edge.. Applicants' new measuring processes and devices take advantage of opportunities for new thinking offered by sophisticated signal processors only recently made possible by advances in technology. By using that sophisticated processing power, processes according to the present invention do not need to be constrained to the assumption that the light is parallel, as in previous technology; instead, they can, for instance, employ a small or point source of light and miniaturize all aspects of their measuring devices. Accordingly, devices which use processes according to the present invention are affordable and can fit in the palm of the hand, yet serve as an accurate and reliable instrument for uses such as measuring wire that is being manufactured.

(6) Sole Issue. The sole issue is whether the one-paragraph rejection of all pending claims as obvious under 35 U.S.C. § 103 is improper, when that paragraph and the two references it applies nowhere teach or suggest the substantive, meaningful and patentably distinct requirements and limitations that are found in the pending claims.

(7) **Grouping of Claims**. For the Board's convenience, a copy of all pending claims 25 – 80 is attached as Exhibit A to this document. A copy of the two references applied by the Examiner are attached as Exhibits B and C. The claims can be considered to form four groups. All claims contain the limitations that information from the array is evaluated (1) according to Fresnel diffraction theory; (2) according to the assumption that the wavefront from the light source is nonplanar; and (3) by distancing the source, article and array such that the intensity pattern in the vicinity of one shadow edge cast by the article is at most negilgably superimposed on the intensity pattern in the vicinity of the other or another shadow edge. Additionally, each group contains additional limitations including the following:

Group I. *Claims 25 – 42* (Independent 25 and dependent claims 26 – 42) form a first group of claims. Independent claim 25 requires that distances between the source, article and array are selected such that the intensity pattern in the vicinity of one shadow edge cast by the article on the array is at most negligibly superimposed on the intensity pattern in the vicinity of the other shadow edge cast by the article on the array.

Group II. *Claims 43 – 48* (Independent 43 and dependents 44 – 48) form a second group of claims. Claim 43 adds the limitation that determination of the dimension of the article includes compensating for the difference between (i) the dimension of the article that casts the intensity pattern; and (ii) the diameter of the article.

Group III. *Claims 49 – 62* (Independent 49 and dependents 50 – 62) form a third group of claims. Claim 49 adds the requirement of at least two sources and two sensors.

Group IV. *Claims 63 – 80* (Independent 63 and dependents 64 – 80) form a fourth group of claims. Claim 63 adds the limitation that the signals from the sensors corresponding to light intensity are filtered in order to attenuate effects of dirt.

(8) **Argument**.

a. Summary of Argument.

The claims at issue (which are all process claims and which include four independent claims, 25, 43, 49 and 63) all address and define measuring a dimension of an article by illuminating a portion of the article with a beam of light in a way that, unlike the cited references, takes advantage of diffraction patterns from light assumed to have a non-planar (or fan-shaped) wavefront. According to all newly pending claims, signals corresponding to the diffraction patterns are evaluated according to Fresnel diffraction theory, and according to the assumption that the wavefront from the light source is nonplanar, to determine the dimension. As discussed below and in the application at the places cited below, applicants' resulting measuring device and processes, even if they involves mathematical analysis of a different and higher degree of complexity than analysis of intensity patterns caused by parallel light, can fit in

the palm of the hand, yet serve as an accurate and reliable instrument for uses such as measuring wire that is being manufactured.

Furthermore, each of the four independent claims adds additional limitations to the invention. Independent claim 25 adds that distances between the source, article and array are selected such that the intensity pattern in the vicinity of one shadow edge cast by the article on the array is at most negligibly superimposed on the intensity pattern in the vicinity of the other shadow edge cast by the article on the array. Claim 43 adds that limitation and, among others, that determination of the dimension of the article includes compensating for the difference between (i) the dimension of the article that casts the intensity pattern; and (ii) the diameter of the article. Claim 49 requires at least two sources and two sensors. Claim 63 adds the limitation that signals from the sensors correspond to light intensity in the intensity pattern in order to attenuate effects of dirt. (Cites to portions of the application which disclose these limitations are listed in Section 8C of this Document.) Clearly, measuring processes having these limitations are not disclosed or suggested in the references cited in this application.

As discussed below, the French reference (identified and discussed more fully in the next section) applied in the one-paragraph rejection discloses measuring the distance between shadow edges cast by an article. It thus discloses a ***geometrical*** approach that treats light as a ray phenomenon, rather than analyzing diffraction patterns as in the present invention.

The other reference applied against the claims, the Ring patent, specifically and expressly considers the French reference's geometrical approach, considers it different, and rejects the geometrical approach. Ring says that the French reference geometrical or ray approach requires a highly accurate, and thus not readily available, light sensor and that it relies too heavily on accurate spacing of the workpiece from the sensor. Ring instead departs away from the geometrical or ray approach by using a large and complex structure with multiple sensors and lenses to create and analyze diffraction patterns from ***parallel light***. Size and complexity may not matter, since the Ring system is shown to measure workpiece dimensions in connection with a lathe-type device. Ring only discloses evaluation of diffraction patterns formed by parallel light, or light having a planar wavefront, a simpler mathematical case than in applicants' invention. Whether that is because Ring was filed circa 1985 before processing power of the sort required by Applicants' invention was readily available, or because the Ring measurement device is disclosed as being used on a lathe-like device to measure apparently sizeable dimensions of a workpiece, what is clear is Ring does not teach or suggest the compact, reliable, accurate device made available by applicants' invention. It certainly does not do that in combination with the French rejection, whose approach it rejects and eschews.

In fact, as mentioned above, the text of Ring expressly teaches away from combining its parallel light approach with the geometrical techniques such as in the French reference. In any event, there is nothing in either Ring

or the French reference that would teach, suggest or incentivize combination of them. Applicants accordingly below respectfully submit that there is not a prima facie obviousness case as required here, and they respectfully request such a position be reconsidered and withdrawn.

b. The References.

The two primary obviousness references that formed the basis for previous obviousness rejections were: (1) U.S. Patent No. 4,854,707 issued August 8, 1989 to *Ring et al* entitled "Method and Apparatus for the Optical Electronic Measurement of a Workpiece" ("Ring patent"); and French publication No. 2,371,673 published June 16, 1978 corresponding to French patent application no. 76 35004 filed November 19, 1976 in the name of "Societe Industrielle De Liaisons Electriques - Silec (the "French reference").

1. <u>French Reference</u>

The February 22, 2002 Examiner's Action, which says precisely the same thing and no more than the previous June 5, 2001 Examiner's action, despite the fact that an entirely new set of claims is involved, recognizes that the French reference shows measuring diameter of an article by placing it in a fan-shaped beam of light and determining where the edges of the resulting shadow are located relative to certain detectors. The Actions recognize that the French document does not teach using diffraction patterns to accomplish this measurement. The Actions take the position, however, that such use of a

diffraction pattern is known in the art as shown by *Ring*. Accordingly, it would have been obvious, says the one-paragraph analysis applied to all 56 claims, to use such diffraction pattern techniques in the device of the French reference. February 22, 2002 Examiner's Action page 2; June 5, 2001 Examiner's Action page 2.

The Actions' position regarding the French reference is correct that while the French reference discloses measurement of the diameter of an elongated article using a fan shaped beam, it does not disclose doing that by analyzing a diffraction pattern. Rather, the French reference discloses measuring the distance between edges of shadows caused by the article, and doing so in a geometric fashion assuming that light is purely a ray phenomenon. The French reference was filed in 1976, before the age of personal computers or ubiquitous and inexpensive microprocessors. There is nothing in the French reference that suggests analysis of a diffraction pattern to measure the diameter of the article, perhaps because the French reference was on file before reasonably priced and available computer technology was available to perform such analysis efficiently and effectively, at a reasonable price point.

2. The Ring Patent

The February 22, 2002 and June 5, 2001 Actions characterize Ring as teaching use of a diffraction pattern resulting from the passage of light over

the edge of an object to improve measurement. February 22, 2002 Examiner's Action page 2; June 5, 2001 Examiner's Action page 2.

Applicants agree that the Ring patent discloses analysis of diffraction patterns to measure dimensions of a work piece. However, no drawing and no text of Ring discloses other than using a source of parallel light to create the diffraction pattern. At Ring, column 3, lines 15-17, by contrast, it is made clear that the radiation is directed parallel. Figures 1 and 6 of Ring make that point distinctly. Figure 1 shows only parallel light rays. There is no drawing or text showing a non-parallel light case.

Ring figure 6 is consonant with the first sentence of the patent which says that the optical electronic method it discloses is for measuring a "work piece." Figure 6 shows a device resembling a lathe, and the light source 3, combined with lens system 7, is a sizeable structure occupying a considerable part of one side of a "sled 22." The sled, which carries the light sources 3 and the lens system 7, is discussed at column 4 lines 26-44. The sled rides on guide rails 21 so that light sensors, light sources and lens can be positioned as desired relative to the work piece. Id.

The Ring apparatus goes to considerable structural effort to illuminate the work piece with parallel light. Ring embraces structural complexity, with multiple lenses and sensors, to create the parallel light diffraction patterns in its quest to escape the geometrical or ray approach as taught in the French reference. For instance, Ring discusses the need to address aberration effects in the lenses (Ring, column 3, lines 18-21). In any event, Ring fails to

disclose or suggest use of any other than a complex structure with multiple lenses and sensors for creating and analyzing a source of parallel light diffraction patterns.

c. Applicants' Invention.

Processes of the invention of the present application and the currently pending newly presented claims do not categorically reject the geometrical or ray based approach of the French reference as Ring does, and are therefore not forced to a embrace a large and structurally complex system that requires a number of lenses and sensors like Ring does. Instead, processes of the present invention reconcile the geometrical or ray approach with the wave phenomenon approach, by using an essentially point source of light in a small and structurally simple system that is based on analyzing a diffraction pattern assuming light with a non-planar wave front. Application page 3, lines 4-5; page 10, lines 11-16; page 10, lines 27-28; Figures 1, 4, 5, 6, 7, 9, 11, 12. The diffraction pattern on the array is analyzed according to Fresnel diffraction theory, a theory that takes into account the non-planar wave front from the point source. Application page 3, line 18 -- page 4, line 15. Because a parallel light source is not required, the light source can be a point source such as a laser diode. Application page 10, lines 11-12. Lenses are not required and if used they can be less complex than in systems which seek to produce parallel light rays. Application page 5, line 21-page 6, line 2. As the attached declaration of inventor Dr. Blohm, filed on December 4, 2001, before

the February 2, 2002 Action (Exhibit D hereto) shows, the use of Fresnel theory to analyze intensity patterns from light assumed to have a nonplanar wavefront now makes it possible to provide a measuring device that can fit in the palm of the hand. That declaration attaches a copy of a sales brochure for the "Inline 2000" Laser 2010XY/Laser 2025XY gauge heads marketed by applicants' company, Sikora Industrieelektronik GmbH.

Furthermore, each of the four independent claims presented above adds additional limitations to the invention claimed therein. Independent claim 25 adds that distances between the source, article and array are selected such that the intensity pattern in the vicinity of one shadow edge cast by the article on the array is at most negligibly superimposed on the intensity pattern in the vicinity of the other shadow edge cast by the article on the array. (Application p. 5, lines 16 –19) Claim 43 adds that limitation and, among others, that determination of the dimension of the article includes compensating for the difference between (i) the dimension of the article that casts the intensity pattern; and (ii) the diameter of the article. (Application p. 4, line 22 – p. 5, line 2) Claim 49 requires at least two sources and two sensors. (Application fig. 4; p. 12, line 19 – p. 13, line 7) Claim 63 adds the limitation that signals from the sensors correspond to light intensity in the intensity pattern in order to attenuate effects of dirt. (Application, p. 6, line 20 – p. 7, line 7; p. 12, lines 1 – 10). Quite clearly, none of the inventions claimed in independent claims 25, 43, 49 or 63, with these limitations, are disclosed or suggested in the references cited in this application.

d. Obviousness Not Established .

(1) No prima facie case of obviousness established. Not only do the French reference (geometrical measurement) and the Ring patent (parallel light diffraction analysis) disclose divergent techniques and devices for measuring dimensions of articles. Not only does the Ring patent expressly distinguish itself from the French reference geometrical types of geometrical measurement techniques. It is also the case that nothing in either of them shows any suggestion of the notion that diffraction patterns should be created and analyzed using processes that only require small and structurally simple systems which assume the light to be a non-planar wave front light phenomenon to measure dimensions of an article. As discussed above, Ring discloses an elaborate structure intended to produce parallel light, and is thus inherently antithetical to the notion of using a small light source to create the more complex non-planar wavefront of light. In any event, there is simply no text from which an inference can be permissibly drawn, much less any express discussion that would provide incentive, suggestion or teaching to combine the Ring diffraction pattern analysis techniques with the French reference geometrical technique.

Furthermore, and more specifically, the Examiner has utterly failed to adduce any showing or suggestion in either of the French Reference or Ring of at least the following highlighted substantive, meaningful and patentably distinguishable limitations in each of claims 25, 43, 49 and 63:

Claim 25: A process for measuring a dimension of an elongated, generally cylindrically-shaped article, comprising:

a. illuminating a portion of the article using a light source which casts a beam with nonplanar wavefront onto the article;

b. receiving said nonplanar wavefront beam on a light sensor array, the article interposed between the array and the light source so that the beam and the article create a intensity pattern as received by the array, the intensity pattern corresponding to a dimension of the article;

c. obtaining from said array a plurality of signals corresponding to light intensity at a plurality of locations in said intensity pattern on said array; and

d. determining said dimension by evaluating information from said signals corresponding to light intensity at a plurality of locations in said intensity pattern in accordance with Fresnel diffraction theory, and according to the assumption that the wavefront from the light source is nonplanar; and

e. wherein distances between the source, the article and the array are selected such that the intensity pattern in the vicinity of one shadow edge cast by the article on the array is at most negligibly superimposed on the int nsity pattern in the vicinity of the other shadow edge cast by th article on the array.

Claim 43: A process for measuring a diameter of an elongated article, comprising:

a. illuminating a portion of the article using a light source which casts a beam with nonplanar wavefront onto the article;

b. receiving said nonplanar wavefront beam on a light sensor array containing a plurality of elements, the article interposed between the array and the light source so that the beam and the article create a intensity pattern as received by the array, the intensity pattern corresponding to a dimension of the article that casts the intensity pattern on the array and the intensity pattern having at least two diffraction patterns;

c. obtaining from said array a plurality of signals, each signal corresponding to light intensity from said beam at the location of an element on said array;

d. determining the distance between the article and a member selected from the group of the light source and the array;

e. determining said dimension by evaluating (a) information corresponding to said distance and (b) information from said signals corresponding to light intensity at a plurality of locations in said intensity pattern in accordance with Fresnel diffraction theory, and according to the assumption that the wavefront from the light sourc is nonplanar;

f. in the process of said determination of said diameter, compensating for the difference between (i) said dimension that casts the intensity pattern on the array and (ii) the diameter of the article; and

g. wherein distances between the source, the article and the array are selected such that the intensity pattern in the vicinity of one shadow edge cast by the article on the array is at most negligibly superimposed on the intensity pattern in the vicinity of the other shadow edge cast by the article on the array.

Claim 49: A process for measuring a dimension of an article, comprising;

a. illuminating a portion of the article using a first light source which casts a first beam with a nonplanar wavefront onto the article;

b. receiving said first beam on a first light sensor array containing a plurality of elements, the article interposed between the first array and the first light source so that the first beam and the article create a first intensity pattern as received by the first array, the first intensity pattern corresponding to the dimension of the article;

c. obtaining from a plurality of elements in said first array a set of first signals corresponding to light intensity from said first beam at a plurality of locations in said first intensity pattern on said first array;

d. illuminating a portion of the article using a second light source which casts a second beam with a nonplanar wavefront onto the article;

e. receiving said second beam on a second light sensor array containing a plurality of elements, the article interposed between the second array and the second light source so that the second beam and the article create a second intensity pattern as received by the second array, the second intensity pattern also corresponding to the dimension of the article;

f. obtaining from a plurality of elements in said second array a set of second signals corresponding to light intensity from said second beam at a plurality of locations in said second intensity pattern on said second array; and

g. determining said dimension by evaluating information from at least one of said first and second sets of signals corresponding to light intensity at a plurality of locations in said first and second intensity patterns in accordance with Fresnel diffraction theory the determination conducted according to the assumption that the wavefront from the light source is nonplanar;

h. wherein determination of said dimension takes into account the difference between the actual dimension of the article and the dimension of a shadow cast on at least one array by the article, the diff r nce b ing caused at least in part by the beam having a nonplanar wavefront.

Claim 63: A process for measuring a dimension of an elongated, generally cylindrically-shaped article, comprising:

a. illuminating a portion of the article using a light source which casts a beam with nonplanar wavefront onto the article;

b. receiving said nonplanar wavefront beam on a light sensor array, the article interposed between the array and the light source so that the beam and the article create a intensity pattern as received by the array, the intensity pattern corresponding to a dimension of the article;

c. obtaining from said array a plurality of signals corresponding to light intensity at a plurality of locations in said intensity pattern on said array; and

d. determining said dimension by evaluating information from said signals corresponding to light intensity at a plurality of locations in said intensity pattern in accordance with Fresnel diffraction theory, and according to the assumption that the wavefront from the light source is nonplanar; and

e. filtering said signals corresponding to light intensity at a plurality of locations in said intensity pattern in order to attenuate effects of dirt.

(2) Ring teaches away from the French Reference. In fact, ***Ring teach s away*** from combining the French reference geometrical or light ray-based measuring technique with diffraction pattern measuring

techniques. Column 1, lines 15-28 of Ring specifically recognizes the existence of prior art optical electronic measuring methods which utilize the shadow produced by a work piece, such as in the French reference. It recognizes that these prior art measuring methods, such as the French reference, use geometrical (ray) optics as opposed to wave optics. Ring, Column 1, lines 22-23; column 1, lines 26 – 34 and column 2, lines 21 - 25. But instead of seeking to improve on such techniques, Ring rejects them: Among other reasons, Ring says that such geometrical (ray) methods often require that precise distances be maintained between the light source, the work piece and the sensor so as to avoid an unfavorable effect on precision if the distances cannot be maintained. It also says at column 1, lines 38-46, that such prior art geometrical (ray) techniques as in the French reference require the light sensors to have a high capacity of resolution. Ring notes that apart from unavailability of such sensors in many cases, seeking to compensate mathematically using purely geometrical (ray)techniques, as in the French reference, detracts from reliability of the measuring results. Id. Accordingly, Ring places the French reference type geometrical (ray) optic solution in a separate category from its own wave optic solution and rejects the geometric (ray) optic solution rather than combining such geometrical (ray) optic techniques with wave optic techniques. *Ring* Column 1, line 18-46.

(3) No sugg stion in either the French Reference or Ring that they should be combined. In any event, there is absolutely no

suggestion in either the French Reference or Ring that the two references should be combined to arrive at Applicants' invention. Nor has the Examiner pointed to any such purported showing. Cases are legion that absence of any suggestion to combine references, as here, is fatal to an obviousness determination. *Northern Telecom, Inc. v. Data Point Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990) (affirming district court holding that claims had not been proved invalid as obvious and holding that the patent challenger must present evidence of some teaching, suggestion or incentive supporting a combination of references). Beyond that, and without belaboring this document with a plethora of citations, it is clear that references which teach away from one another only strengthen the nonobviousness case. Accordingly, the Actions to date have failed to establish a prima facia case that the pending claims are obvious.

CONCLUSION

In view of the foregoing, Applicants respectfully request that the Examiner carefully consider this application and the 56 pending claims in view of the analysis above, and allow all claims or provide adequate and proper explanation and showing why not.

Respectfully submitted,

James L. Ewing, IV
Reg. No. 30630
Attorney for Applicants

Of counsel:

Kilpatrick Stockton LLP
Suite 2800
1100 Peachtree Street NW
Atlanta, GA 30309-4530
404.815.6494 (t)
404.815.6555 (f)